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Specification

1. Title of Invention

Fire Retarding Treatment for Lumber

2. Claim

A fire retarding treatment for lumber, characterized in that after lumber of the araucaria family has been pressurized with steam, resin content is removed while reducing the pressure; the lumber is dried, impregnated with a partially reacted product of dicyandiamide, phosphoric acid, boric acid and water, and thereafter dried.

3. Detailed Description of the Invention

[Field of Industrial Application]

This invention pertains to a fire retarding treatment for lumber. In particular, this invention is to increase the amount of a fire retarding agent impregnated by removing resin that causes to catch a fire by providing a process to reduce a pressure after the lumber has been pressurized with steam.

[Prior Art]

A variety of methods are conventionally used for impregnating fire retarding agents into lumber. A halogen fire retarding agent and an inorganic phosphorus fire retarding agent are used as the fire retarding agents. Nevertheless, the halogen fire retarding agent is not suited in terms of safety and hygiene since it generates a toxic gas during combustion. The inorganic phosphorus fire retarding agent does not demonstrate a high fire retarding effect.

Accordingly, in the recent years, a partially reacted product of dicyandiamide, phosphoric acid, boric acid and water has been known as a fire retarding agent to add fire retardancy to lumber in lieu of the aforementioned fire retarding agents (Japanese unexamined patent application No. S57-70178, etc.). This fire retarding agent demonstrates an effect of preventing ignition to the lumber and delaying the combustion speed of the lumber by forming a carbonized hard layer on the surface layer of the lumber during combustion.

[Problem to Be Solved by the Invention]

A location where resin is collected in the conduit, more specifically, a resin pocket is usually presented on lumber. The amount of resin presented varies by the wooden types. The resin is presented at about 2 to 3% on the entire lumber of the araucaria family in which resin content is relatively small.

However, when resin content is collected in the conduit, it causes to catch afire and prevents the fire retarding agent to be impregnated at a large amount. Even if a fire retarding treatment is applied to the lumber, when the lumber per se contains resin content, high fire retardancy cannot be obtained. As a result, lumber that meet a standard

value of a “quasi incombustible material” test specified in Notification No. 1231 of the Ministry of Construction cannot be obtained.

As it is necessary for a fire retarding treatment to use such lumber that does not contain resin content, only lumber with a smaller amount of resin is usually selected before the fire retarding treatment.

Nevertheless, the selecting process is complicated whereas lumber containing resin content is wasted.

In consideration of the above situation, the invention aims to offer a fire retarding treatment method for lumber that is capable of removing the cause of ignition by removing resin with an easy means and improving the amount of the fire retarding agent impregnated.

[Measures for Solving the Problem]

The invention uses a measure to solve the problem, such that after lumber of the araucaria family has been pressurized with steam, resin content is removed while reducing the pressure; the lumber is dried, impregnated with a partially reacted product of dicyandiamide, phosphoric acid, boric acid and water, and thereafter dried.

[Effect]

Because the process to remove resin as a cause of catching a fire by applying the pressure reducing process after the pressurization with steam, an ignition during a combustion can be prevented or controlled. As resin collected in the conduit is also

removed by cleaning the conduit, the amount of the fire retarding agent impregnated increases, thereby significantly improving the fire retardancy.

The invention is described below in detail.

The araucaria family used for the invention is a general term for agathis, *A. philippinensis* warb, etc., in which the amount of the fire retarding agent impregnated is large, no partial fluctuation occurs at the impregnating state and the impregnating concentration, and which the amount of resin content contained is relatively small. Agathis is particularly preferred.

First, lumber is pressurized with steam. The pressure is then reduced to perform a steam cleaning. It is preferred in terms of the cleaning efficiency that a piece of lumber of about 40 x 40 x 200 mm is produced in advance by roughly shaping the lumber before the steam cleaning. The conduit of the lumber is cleaned by the steam cleaning to remove resin content collected inside the conduit whereas the amount of the fire retarding agent impregnated at a post-process improves. The steam cleaning is not limited to any method. For example, two chambers are separately vertically provided with a duckboard like partition plate. The lumber is arranged on the partition plate inside a steam cleaning chamber that can add or reduce a pressure. Steam is then ejected to the lumber from four directions and also upper and lower directions. The ejection of the steam can be continuously applied for 1 to 2 hours at a pressure of 0.1 to 0.2 MPa when we take the fact that the temperature inside the cleaning chamber and the temperature of the center of lumber become equivalent in almost 20 to 30 minutes into consideration. If the pressure exceeds 0.2 MPa, the color of the lumber changes, which is not desirable. After this, the pressure is reduced at a vacuum level of 450 to 600 Torr for about 20 minutes to 1 hour

while increasing the temperature to 60 to 80°C. Defining such a cleaning pattern of the steam pressurization and the pressure reduction as one cycle, about 1 to 10 cycles are repeated according to the type and size of lumber. By these means, resin content of the lumber is expelled and drops onto the chamber from the duckboard like partition plate.

Next, the lumber of the araucaria family is dried. Either natural drying or artificial drying is applied and preferably applied so that the water containing ratio of the lumber becomes about 9 to 15%.

A fire retarding agent is thereafter impregnated in the lumber.

This fire retarding agent is a partially reacted product of dicyandiamide, phosphoric acid, boric acid and water, which is disclosed in Japanese unexamined patent application No. S57-70178 as described above. The fire retarding agent mainly contains guanylurea phosphate produced by a reaction between dicyandiamide and phosphoric acid, a guanylurea phosphate-boric acid product produced by a reaction of guanylurea phosphate to boric acid, unreacted dicyandiamide, unreacted phosphoric acid and unreacted boric acid. As an example, there is a fire retarding agent prepared in the form of a solution at a 20% concentration, which is not limited to it.

The partially reacted product of dicyandiamide, phosphoric acid, boric acid and water is impregnated in the lumber of the araucaria family at 1000 kg or greater per 1 m³ lumber by the amount of a solid portion. In particular, lumber with higher fire retardancy that meets the standard value of the “quasi incombustible material” test specified in Notification of the Ministry of Construction No. 1231. Because the fire retarding agent is uniformly impregnated, it is preferably impregnated at 500 kg or more per 1 m³ lumber in

the form of a solution. If the impregnating amount is below 100 kg, the fire retardancy improving effect of the lumber cannot be sufficiently attained, which is not desirable.

At the impregnating operation, a pressurization impregnating method using an autoclave is usually adopted. In detail, the lumber is supplied in the autoclave. After the pressure has once been reduced for about 30 minutes under a reduced pressure of about 160 Torr, the fire retarding agent is supplied into the autoclave by an injecting means. While the lumber is immersed in the fire retarding agent solution, a pressure is exerted to impregnate the fire retarding agent in the lumber. At the time, a condition of a 1.2 to 3.0 MPa pressure is preferably applied so as to smoothly impregnate the fire retarding agent in the aforementioned range of amount in the lumber.

After the impregnation of the fire retarding agent, the lumber is dried to obtain desired fire retarding lumber. At the time, the drying operation is preferably applied while the lumber opening is sealed to prevent cracking of the lumber opening due to dryness as water content alone is eliminated without volatilizing the impregnated fire retarding agent due to the drying operation. The lumber is sealed by a regular mean, which is suitably a means for applying a coating agent containing epoxy synthetic resin mixed with tar. The drying operation is performed so that the water containing ratio of the lumber becomes about 8 to 12%, which is usually achieved by a vacuum heating drying at a vacuum level of an about 0.1 to 10 Torr at about 60 to 80°C.

According to the fire retarding treatment for the lumber, resin content that causes to catch a fire is removed as the steam cleaning process is applied, thereby preventing or controlling the catching a fire. As the amount of the fire retarding agent impregnated also increases, the fire retardancy significantly improves. Due to the steam cleaning, an

operation to select lumber without having resin content alone is not required before the fire retarding agent is impregnated unlike prior art fire retarding treatment, thereby reducing the labor and the time. A disadvantage such that lumber containing resin content is wasted is also eliminated, which is a significant economical advantage.

[Working Example]

(Working Example)

Agathis of the araucaria family previously not usable as lumber because it contains a large amount of resin is used. After drying agathis, four pieces of square timber of an about 40 x 40 x 2000 mm are prepared by applying a rough shaping to the same lumber. A steam cleaning is applied to two pieces among the four pieces (the other two pieces are used for the comparative example as described below). The steam cleaning is applied by repeating a cleaning pattern for two cycles, wherein the pressure is reduced at 60°C at a vacuum level of 500 Torr for 30 minutes after steam pressurization has been applied at a pressure of 0.15 MPa for 1 hour. The partially reacted product of dicyandiamide, phosphoric acid, boric acid and water, disclosed in Japanese unexamined patent application No. S57-70178, is used as a fire retarding agent. The fire retarding agent is impregnated in the lumber, such that the lumber is immersed in the fire retarding agent after the pressure has been reduced at 160 Torr for 30 minutes and then pressurized at a pressure of 1.5 MPa for 4 hours.

(Comparative Example)

A fire retarding treatment as described in the working example is applied to lumber as similarly to as in the working example except for an absence of the steam cleaning before the fire retarding agent is impregnated in the lumber.

The amounts of the fire retarding agents in the obtained fire retarding lumber as in the working example and the comparative example are measured to conduct an ISO ignitability test and a “quasi incombustible material” test. The “quasi incombustible material” test is applied by using a method specified in Notification of the Ministry of Construction No. 1231 and No. 1372, and the results are collectively indicated in Table 1.

Table 1

	Amount impregnated (kg/cm ³) 1)	ISO ignitability test (amount of radiation 4W/cm ²)	Part of items of the “quasi incombustible material’ test	
			Surface test	Punching test
Working example	121	N.I 2)	[Please see the original description]	
Comparative example	200	25 seconds		

1) Amount of a solid portion per 1 m³ lumber.

2) N.I: not ignited in 15 minutes

Based on Table 1, it is clear in Table 1 that the ignition of the fire retarding lumber that has been steam-cleaned as in the working example is controlled in comparison with the fire retarding lumber that has not been steam-cleaned as in the comparative example. It is evident that the amount of the fire retarding agent impregnated in the fire retarding lumber of the working example is larger to achieve improved fire retardancy.

[Advantageous Effect of the Invention]

As described above, according to the invention, after the steam pressurization of the lumber of the araucaria family, the pressure is reduced to remove resin content. After the drying operation, the partially reacted product of dicyandiamide, phosphoric acid, boric acid and water is impregnated. The drying operation is applied again. Because of the provision of the cleaning process to reduce the pressure after the steam pressurization, resin content that causes ignition during combustion is removed to prevent or control the ignition whereas the amount of the fire retarding agent increases, thereby significantly improving the fire retardancy. Because of the cleaning of resin content while reducing the pressure after the steam pressurization, the selecting operation for lumber that hardly contain resin before the impregnation of the fire retarding agent is not required unlike prior art fire retarding treatment, thereby reducing the labor and the time and also eliminating the wasting of lumber containing resin. Therefore, the fire retarding treatment of the invention is highly advantageous in terms of the cost.

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Chisato Morohashi